3.6 What is implicit differentiation?
3.7 How to use implicit differentiation to get an equation of *rates of change?*

2014-10-29 day 45

fire drill spot: 18C

3.6/17 $\sin(x^2y^2) = x$

$\cos(x^2y^2)\cdot\frac{d}{dx}(x^2y^2) = 1$

$\cos(x^2y^2)\cdot\left[\frac{d}{dx}(x^2)y^2 + x^2\frac{d}{dx}(y^2)\right] = 1$

$\cos(x^2y^2)\cdot\left[2xy^2 + x^2\left(2y\frac{dy}{dx}\right)\right] = 1$

$2xy^2 + 2x^2y\frac{dy}{dx} = \frac{1}{\cos(x^2y^2)} = \sec(x^2y^2)$

3.6/17

$2x^2y\frac{dy}{dx} = \sec(x^2y^2) - 2xy^2$

$\frac{dy}{dx} = \frac{\sec(x^2y^2) - 2xy^2}{2x^2y}$

$= \frac{\frac{1}{\cos(x^2y^2)} - 2xy^2}{2x^2y} = \frac{\frac{1 - \cos(x^2y^2)2xy^2}{\cos(x^2y^2)}}{2x^2y}$

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2014-10-29 day 45

fire drill spot: 18C

3.6/19) $\tan^3(xy^2+y)=x$

$\frac{d}{dx}$: $3(\tan(xy^2+y))^2 \cdot \frac{d}{dx}(\tan(xy^2+y)) = 1$

$3(\tan(xy^2+y))^2 \cdot \sec^2(xy^2+y) \cdot \frac{d}{dx}(xy^2+y) = 1$

$3(\tan(xy^2+y))^2 \sec^2(xy^2+y) \cdot \left[\frac{d}{dx}(x)\cdot y^2 + x\frac{d}{dx}(y^2) + \frac{d}{dx}(y)\right] = 1$

$3(\tan(xy^2+y))^2 \sec^2(xy^2+y)\left[y^2 + 2xy\frac{dy}{dx} + \frac{dy}{dx}\right] = 1$

$y^2 + 2xy\frac{dy}{dx} + \frac{dy}{dx} = \frac{1}{3\tan^2(xy^2+y)\sec^2(xy^2+y)}$

$\therefore \quad \frac{dy}{dx} = \frac{\frac{1}{3\tan^2(xy^2+y)\sec^2(xy^2+y)} - y^2}{(2xy+1)}$

$2xy\frac{dy}{dx} + \frac{dy}{dx}$

$\frac{dy}{dx}(2xy+1)$

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2014-10-29 day 45

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3.6/21) $3x^2 - 4y^2 = 7$

boo hoo $\frac{d}{dx}$: $6x - 8y\frac{dy}{dx} = 0$

$\frac{dy}{dx} = \frac{-6x}{-8y} = \frac{3x}{4y}$

$\frac{d^2y}{dx^2} = \frac{\frac{d}{dx}(3x)\cdot 4y - (3x)\frac{d}{dx}(4y)}{(4y)^2}$

$\frac{d^2y}{dx^2} = \frac{12y - 12x\frac{dy}{dx}}{(4y)^2} = \frac{12y - 12x\left(\frac{3x}{4y}\right)}{16y^2}$

$= \frac{48y^2 - 36x^2}{\frac{4y}{16y^2}} = \frac{48y^2 - 36x^2}{64y^3}$

$= \frac{4(12y^2 - 9x^2)}{4(1}$

$6 - 8\left[\frac{dy}{dx}\left(\frac{dy}{dx}\right) + y\frac{d^2y}{dx^2}\right] = 0$

$\left(\frac{dy}{dx}\right)^2 + y\frac{d^2y}{dx^2} = \frac{3}{4}$

$\left(\frac{3x}{4y}\right)^2 + y\frac{d^2y}{dx^2} = \frac{3}{4}$

$y\frac{d^2y}{dx^2} = \frac{3}{4} - \frac{9x^2}{16y^2}$

$y\frac{d^2y}{dx^2} = \frac{12y^2 - 9x^2}{16y^2}$

$\frac{d^2y}{dx^2} = \frac{12y^2 - 9x^2}{16y^3}$

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36(23) $x^3y^3=4$

$$\frac{d}{dx}(x^3)\cdot y^3+x^3\cdot\frac{d}{dx}(y^3)=0$$

$$3x^2y^3+x^3(3y^2\frac{dy}{dx})=0$$

$$3x^3y^2\frac{dy}{dx}=-3x^2y^3$$

$$\frac{dy}{dx}=\frac{-3x^2y^3}{3x^3y^2}=-\frac{y}{x}$$ ★

$$\frac{d^2y}{dx^2}=-\frac{\frac{d}{dx}(y)\cdot x-y\cdot\frac{d}{dx}(x)}{x^2}$$

$$=-\frac{x\frac{dy}{dx}-y}{x^2}=-\frac{x(-\frac{y}{x})-y}{x^2}=-\frac{-2y}{x^2}$$

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